

**Table 3**  
**Comparison of Various ITS Communication Media**

Medium	Bandwidth	Suited for	Special needs	Cost	Reliability
Fiber optics	>1 Gbps	High-bandwidth backbones, video transmission, interjurisdictional interfaces; connecting field equipment to hubs (as for copper below)	Maintenance staff requires special training. Max distance depends on design but can be 30 miles.	Initial outlay similar to copper; requires less maintenance, but equipment and training is more costly	Excellent; fiber connections can be designed to be fault-tolerant
Twisted-pair copper	Approx. 50 Kbps with modems; 2 Mbps with DSL	Connecting field equipment (low-bandwidth data, controllers, message signs, etc.) to communication hubs. Video up to one mile.	None. Max distance typically on the order of one mile without repeaters to boost signal strength.	Cost driven by the need for conduit; new conduit runs are about \$30 per foot	Very good; failures are generally attributable to construction inadvertently cutting a link
Microwave	Up to approx. 50 Mbps	Connecting field equipment (data circuits) to hubs; video transmission; interjurisdictional interfaces	Requires line-of-sight between antennas; high-bandwidth equipment requires environmental enclosures; generally requires FCC licensing. Max distance varies from 1 to 20 miles; depends on frequency and antenna gain.	Lower bandwidth connections (controller to controller daisy chains) are approximately \$10,000 per link	Very good; disruptions generally due to heavy fog and rain, which worsens if antenna separation is near design limit; or antenna misalignment
Spread-spectrum radio	Up to approx. 20 Kbps	Connecting field equipment (data circuits) to hubs	Requires line-of-sight between antennas. Max distance is subject to antenna configuration but can be assumed similar to microwave.	Approximately \$10,000 per link	Very good; disruptions generally due to weather, heavy interference from other spectrum users, or antenna misalignment
Leased land lines (dial-up modem, T1, etc.)	Essentially unlimited; price paid is proportional to bandwidth	Connection of isolated field equipment; interjurisdictional interfaces	None	Low initial cost, but per-month cost charged by vendor; dial-ups are \$10/mo; leased lines start at \$300/mo. for 56 Kbps	Very good
Subscriber wireless (CDPD, etc.)	19.2 Kbps	Connection of isolated field equipment	None	Low initial cost, but per-month cost charged by vendor; charge is per unit and per kilobyte transmitted; \$50/unit/mo. is good budget amount	Good to very good; not all technologies proven for ITS market